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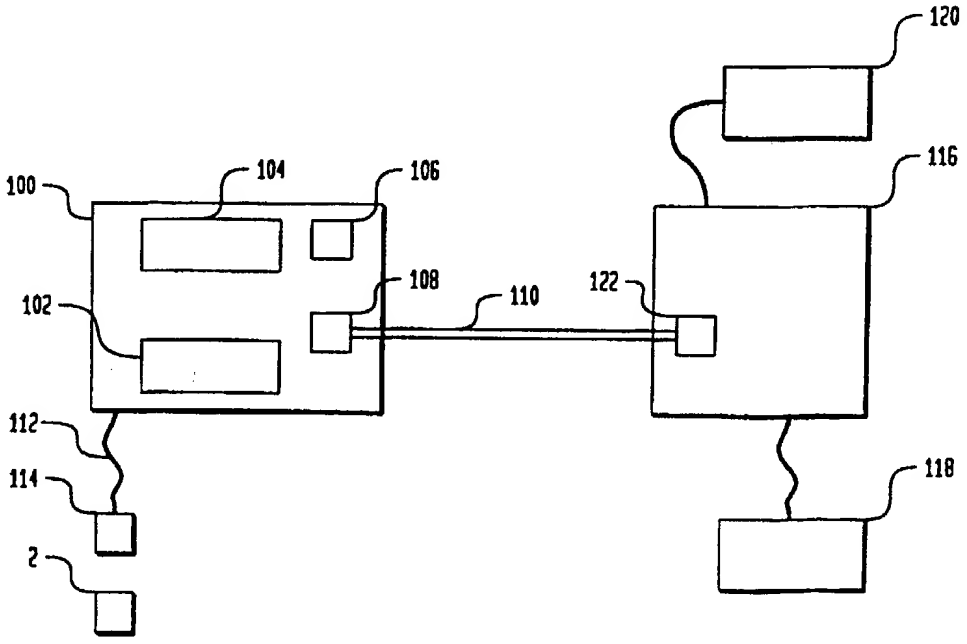

(57) Abstract

A programming unit is used to program programmable hearing aids. Information stored in the programming unit is electrically transferred to a computer to update a database of patient prescription information.

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SYSTEM FOR PROGRAMMING PROGRAMMABLE HEARING AIDS AND UPDATING DATABASE OF PATIENT INFORMATION

Background of the Invention

The invention relates to hearing aids, and more particularly relates to hearing aids of the programmable type. In its most immediate sense, the invention relates to apparatus used by an audiology office to program programmable hearing aids and to maintain a computer database of patient information.

A programmable hearing aid is pre-programmed by a dispenser to match the needs of the patient. Thus, for example, when programming a Siemens TRITON aid, the dispenser establishes, for each of three frequency bands, the gain and the automatic gain control; the dispenser also establishes the crossover frequencies between the first and second bands, and between the second and third bands. Alternatively, when programming a Siemens INTELIVENIENCE aid, the dispenser establishes the applicable gain for soft sounds, the applicable gain for medium level sounds and the applicable gain for loud sounds, together with an intelligent response modifier.

Programmable hearing aids are programmed using a separate programming unit. For example, programmable hearing aids manufactured by Siemens may be programmed using a unit known as the Personal Programmer 2000. This unit makes an electrical connection (as by insertion of a connector) with the aid to be programmed and presents the audiologist with an organized routine by which the necessary (hearing aid type-specific) information is programmed into the aid.

An audiologist's duties continue after the patient's aid has been programmed. The audiologist must also record the settings for the patient's hearing aid prescription and must update the patient's medical records. For example, if a patient's hearing changes, the patient's prescription must change as well. These changes must be noted, so that the patient's current

condition can be immediately known and so that e.g. the deterioration of the patient's hearing can be determined and quantified. Conventionally, patient prescription records are maintained in database form on a personal computer; Siemens distributes CONEXX software adapted to this task.

If an audiologist does fittings outside the office, substantial time and effort may be involved in reprogramming patients' aids and updating patients' records. For example, when an audiologist visits patients at home, in the hospital or in the workplace, the audiologist tests the patient's hearing and (if necessary) adjusts the patient's prescription to correct for any changes since that patient's last appointment. During this process, the audiologist may need to record many items of information (e.g. new audiological data for the left and right ear and a new prescription for each). Then, when the audiologist returns to the office, the patient prescription database must be updated with the new information. The effort involved in doing this can be substantial. If an audiologist schedules multiple patients for a single visit (as when the audiologist visits a nursing home or a hospital) the effort involved in updating the database can be burdensome.

It would be advantageous to provide method and apparatus for making it easier to update computer-maintained patient prescription data for programmable hearing aids.

One object of the invention is to provide method and apparatus for programming programmable hearing aids and for updating a computer database containing patient prescription data.

Another object is, in general, to improve on audiological methods and apparatus.

In accordance with the invention, a programming unit is provided. The programming unit is detachably electrically connectable to a programmable hearing aid,

and includes means for programming the hearing aid when electrically connected thereto, means for inputting and storing information provided by an audiologist, and means for transmitting, to a receiving location, information stored in the programming unit. The inputting and storing means is capable of operative interaction with said programming means in a manner that information input to the programming unit can be used to program the hearing aid, and the transmitting means is capable of operative interaction with said inputting and storing means in a manner that information stored in the programming unit can be transmitted to a receiving location.

In further accordance with the invention, a host computer is provided. Also provided is a means detachably electrically connecting the programming unit to the computer. The detachably electrically connecting means is capable of operative interaction with said transmitting means and host computer in a manner that information stored in the programming unit can be transmitted to the host computer to update information stored in the host computer.

Thus, in accordance with the invention, when new information is input to the programming unit, the new information can be used to program (or reprogram) the programmable hearing aid and also to update the computer database.

Advantageously, and in accordance with the preferred embodiment, the programming unit stores information in an EEPROM and transmits the information to the host computer via an RS-232 serial port and a serial cable. Further advantageously, the host computer is a master unit and the programming unit is a slave unit, which is controlled by the host computer and transfers data to the host computer.

Brief Description of the Drawings

The invention will be better understood with

reference to the following illustrative and non-limiting drawings, in which:

Fig. 1 schematically illustrates conventional apparatus presently used by audiologists to program programmable hearing aids and to maintain patient prescription information in an office computer;

Fig. 2 shows audiological data of the type audiologists maintain in a computer database on a host computer;

Fig. 3 shows examples of parameters that may be programmed into programmable hearing aids;

Fig. 4 schematically illustrates apparatus in accordance with the preferred embodiment of the invention;

Fig. 5 is a flowchart illustrating operation of apparatus in accordance with the preferred embodiment; and

Fig. 6 illustrates fields of database information that are advantageously included in a database resident on a computer used in an audiology office.

Detailed Description of a Preferred Embodiment

In Fig. 1, a programmable hearing aid 2 (such as the aids manufactured by Siemens under the TRITON, INFINITI, INTELIVENIENCE and FRONTIER marks) is programmed by a user-operated programming unit 4. The programming unit 4 has a keyboard 6, a display 8, and a programming cable 10. At the distal end of the programming cable 10 is located one or more connectors 12. The connector(s) 12 are adapted to fit into one or more of the aids 2. When an aid 2 is to be programmed, a connector 12 is plugged into the aid 2, the audiologist inputs the necessary information to the programming unit 4 via the keyboard 6 and display 8, and uses the keyboard 6 to program the aid 2. Thereafter, the connector 12 is disconnected from the aid 2.

The audiologist also maintains a patient prescription database on a host computer 14. The

computer 14 also has a keyboard 16 and a display 18. When this database is to be updated (with new information about the patient's hearing or about the prescription information newly programmed into an aid 2), the new information must be input using the keyboard 16 and display 18.

The process of updating the database can be time-consuming, and errors can be introduced when the data is being transcribed. This is because the amount of data can be substantial. For example, let it be assumed that a patient wears a hearing aid in each ear, has undergone a new hearing test, and needs a new prescription for a TRITON aid. As can be seen from Fig. 2, the new test may produce 33 data items (3 for each of 11 frequencies). Furthermore, Fig. 3 shows that 8 parameters are needed to program the aid. The TRITON aid is designed to be thus programmed for up to 4 situations. Therefore, to update the database for only this single patient, 65 data items (33 audiological data items plus 8 x 4 = 32 prescription data items) must be input to the computer 14.

In accordance with the preferred embodiment as illustrated in Fig. 4, a programming unit 100 has a keyboard 102, a display 104, an EEPROM 106, and an RS-232 serial port 108 and serial cable 110. The programming unit 100 also has a programming cable 112 terminated with one or more connectors 114.

A host computer 116 also has a keyboard 118, a display 120, and an RS-232 port 122 to which the serial cable 110 may be connected. When the computer 116 is connected to the programming unit 100 via the serial cable 110, the computer 116 operates as a master unit and the programming unit 100 operates as a slave unit.

In use, the preferred embodiment operates in accordance with the flowchart shown in Fig. 5. First, audiological information for the patient is input to the programming unit 100 and the patient's hearing aid is adjusted. Then, once the dispenser decides to save this

information, the name of the patient is input to the programming unit 100 (using the keyboard 102 and display 104). When this information is to be saved, it is stored in the EEPROM 106 and retained.

This process may be repeated up to four additional times; the EEPROM 106 of the programming unit 100 is chosen to retain all necessary information for five different patients. If the audiologist attempts to enter information relating to a sixth patient, the display 104 indicates that this cannot be done until the information in the EEPROM 106 has been transferred to the host computer 116.

To carry out such a transfer, the serial cable 110 is connected between the programming unit 100 and the computer 116. Then, using the keyboard 118 and display 120, the computer 116 locks the keyboard 102 of the programming unit 110 and reads the name of the first patient whose information is stored in the EEPROM 106. The computer 116 then finds the best match between the names in its database and the name just read from the programming unit 110. If the database in the computer 116 has an entry for that patient, the audiologist is prompted to confirm that the patient is the same. If so, the computer 116 causes the corresponding data in the EEPROM 106 to update the information in the computer 116 and to delete this data from the EEPROM 106. When so updated, the computer 116 advantageously retains the information originally stored therein, so the dispenser can know how the patient's hearing has changed over time.

If the information in the EEPROM 106 relates to a patient who is absent from the database in the computer 116, the computer will prompt the audiologist to enter the necessary additional information (e.g. address, telephone, age etc., see Fig. 6) into the database.

This process is repeated until all the information in the EEPROM 106 has been transferred to the computer 116. Once all information in the EEPROM 106 of the

programming unit 100 has been transmitted to the computer 116, the audiologist exits the program on the computer 116. The EEPROM 106 of the programming unit 100 is emptied, and ready to store information relating to five patients.

While use of RS-232 serial ports is presently preferred, this is not necessary; parallel ports, optical or RF links could be used instead.

Although a preferred embodiment has been described above, the scope of the invention is limited only by the following claims:

1. A system for use by audiologist personnel to program programmable hearing aids and to update a database residing on a computer, comprising:

a programming unit, the programming unit being detachably electrically connectable to a programmable hearing aid and including

means for programming the hearing aid when electrically connected thereto,

means for inputting and storing information provided by an audiologist, said inputting and storing means being capable of operative interaction with said programming means in a manner that information input to the programming unit can be used to program the hearing aid, and

means for transmitting, to a receiving location, information stored in the programming unit, said transmitting means being capable of operative interaction with said inputting and storing means in a manner that information stored in the programming unit can be transmitted to a receiving location;

a host computer; and

means detachably electrically connecting the programming unit to the computer, said detachably electrically connecting means being capable of operative interaction with said transmitting means and host computer in a manner that information stored in the programming unit can be transmitted to the host computer to update information stored in the host computer.

2. The system of claim 1, wherein the means for inputting and storing comprises a keyboard and a display.

3. The system of claim 1, wherein the means for inputting and storing comprises an EEPROM.

4. The system of claim 1, wherein said transmitting means comprises an RS-232 serial port, wherein said detachably electrically connecting means comprises a serial cable, and wherein the host computer includes an RS-232 serial port.

5. A method for programming programmable hearing aids and maintaining and updating a hearing prescription database residing on a host computer, comprising the following steps:

providing a programmable hearing aid;

providing a programming unit for programming the hearing aid;

providing a host computer with a hearing prescription database residing thereon;

inputting information into the programming unit;

programming the hearing aid using the programming unit; and

updating the database on the host computer using the programming unit.

6. The method of claim 5, wherein the inputting step comprises the steps of inputting a patient name, inputting audiological data characteristic of the patient, and inputting at least one programmable hearing aid parameter.

7. The method of claim 5, wherein the programming step comprises the steps of establishing an electrical connection between the programming unit and the hearing aid, transmitting information from the programming unit to the hearing aid in electrical form, and breaking the electrical connection between the programming unit and the hearing aid.

8. The method of claim 5, wherein said updating step is carried out using the computer as a master and the programming unit as a slave.

FIG. 1
(PRIOR ART)

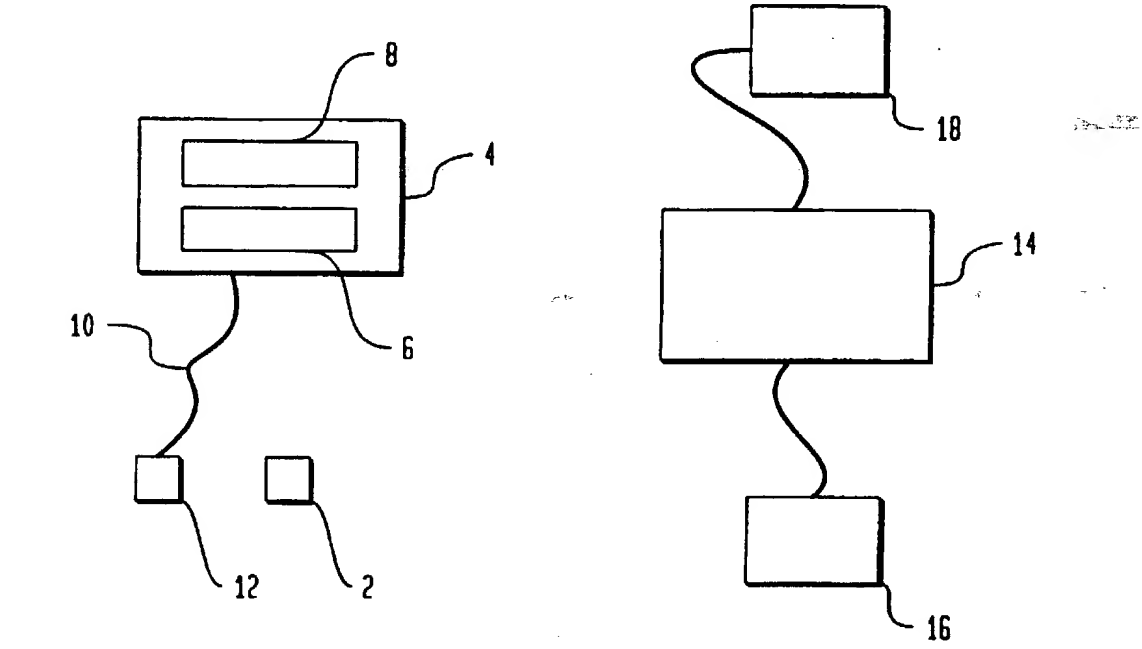


FIG. 2

AUDIOLOGICAL DATA

FREQUENCY	DATA STORED		
125	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
250	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
500	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
750	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
1000	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
1500	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
2000	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
3000	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
4000	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
6000	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL
8000	AIR THRESHOLD	BONE THRESHOLD	UNCOMFORTABLE LEVEL

FIG. 3

HEARING INSTRUMENT PARAMETERS:

TRITON

PARAMETER NAME	DESCRIPTION/FUNCTION
G1	GAIN 1 THE GAIN OF THE BAND LOCATED BETWEEN 0Hz AND CROSSOVER FREQ. F1
G2	GAIN 2 THE GAIN OF THE BAND LOCATED BETWEEN CROSSOVER FREQ. 1 AND 2
G3	GAIN 3 THE GAIN OF THE BAND LOCATED BETWEEN CROSSOVER FREQ. 2 AND 8KHz
F1	CROSSOVER FREQ. 1. DETERMINES THE FREQ. WIDTH OF THE FIRST BAND
F2	CROSSOVER FREQ. 2. DETERMINES THE FREQ. WIDTH OF THE SECOND BAND
A1	AUTOMATIC GAIN CONTROL FOR BAND 1
A2	AUTOMATIC GAIN CONTROL FOR BAND 2
A3	AUTOMATIC GAIN CONTROL FOR BAND 3

INFINITI

PARAMETER NAME	DESCRIPTION/FUNCTION
GAIN	THE OVERALL GAIN OF THE HEARING INSTRUMENT
NL	HI CUT FREQUENCY ADJUSTMENT
NH	LOW CUT FREQUENCY ADJUSTMENT
AGC	AUTOMATIC GAIN CONTROL

INTELIVENIENCE

PARAMETER NAME	DESCRIPTION/FUNCTION
G40	GAIN FOR SOFT SOUNDS
G65	GAIN FOR MEDIUM LEVEL SOUNDS
G90	GAIN FOR LOUD SOUNDS
IRM	INTELLIGENT RESPONSE MODIFIER

INFINITI 3

PARAMETER NAME	DESCRIPTION/FUNCTION
GAIN	THE OVERALL GAIN OF THE HEARING INSTRUMENT
SC	SLOPE CONTROL (SELECTION OF SLOPE FROM 500 TO 1KHz)
NH	LOW CUT FREQUENCY ADJUSTMENT
NL	HI CUT FREQUENCY ADJUSTMENT
AGC	AUTOMATIC GAIN CONTROL
PC	MAXIMUM OUTPUT OF THE HEARING INSTRUMENT

FRONTIER

PARAMETER NAME	DESCRIPTION/FUNCTION
MG	MASTER GAIN. THE OVERALL GAIN OF THE HEARING INSTRUMENT
LFG	LOW FREQ. GAIN (AMPLIFICATION FOR SOUNDS UNDER 1KHz)
HFG	HIGH FREQ. GAIN (AMPLIFICATION FOR SOUNDS ABOVE 3KHz)
CK	AGC KNEEPOINT
CR	COMPRESSION RATIO FOR AGC CIRCUIT

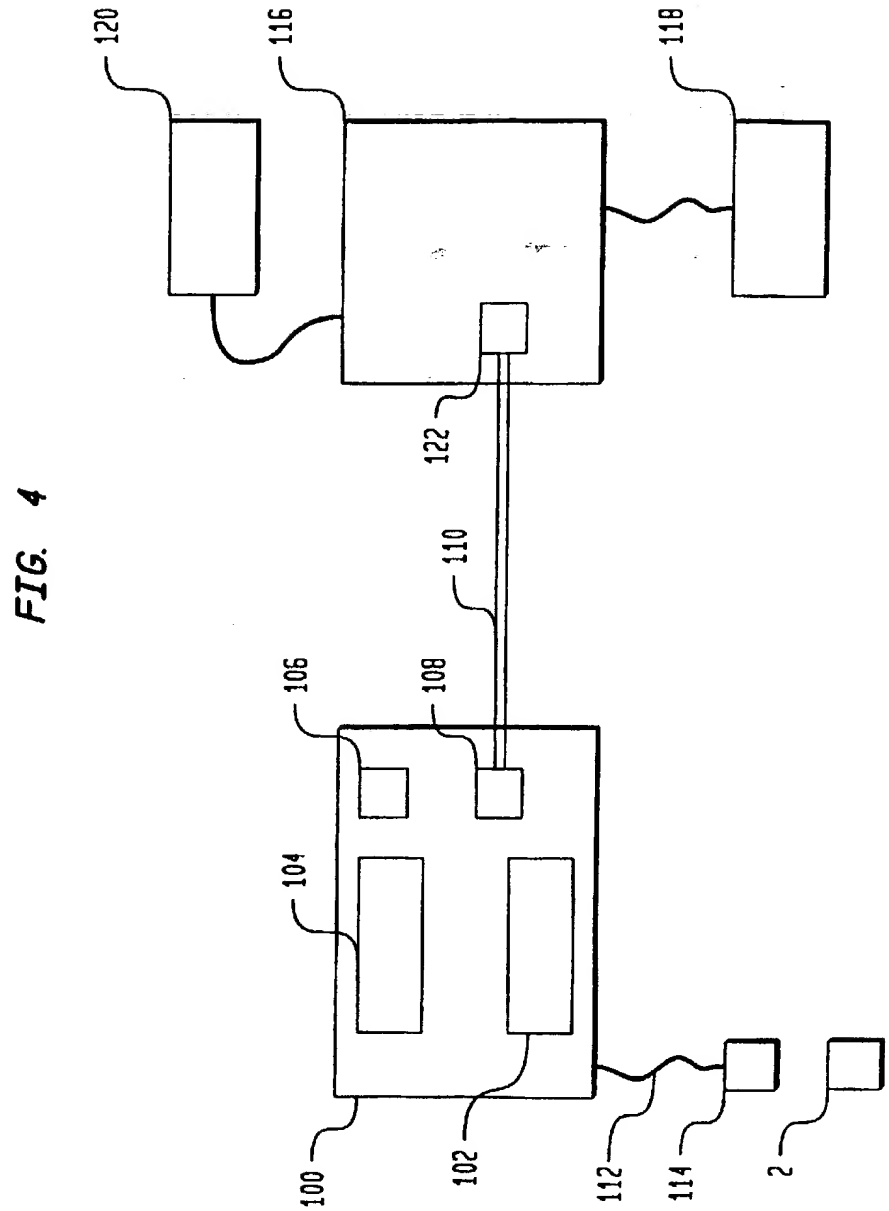


FIG. 4

FIG. 5A

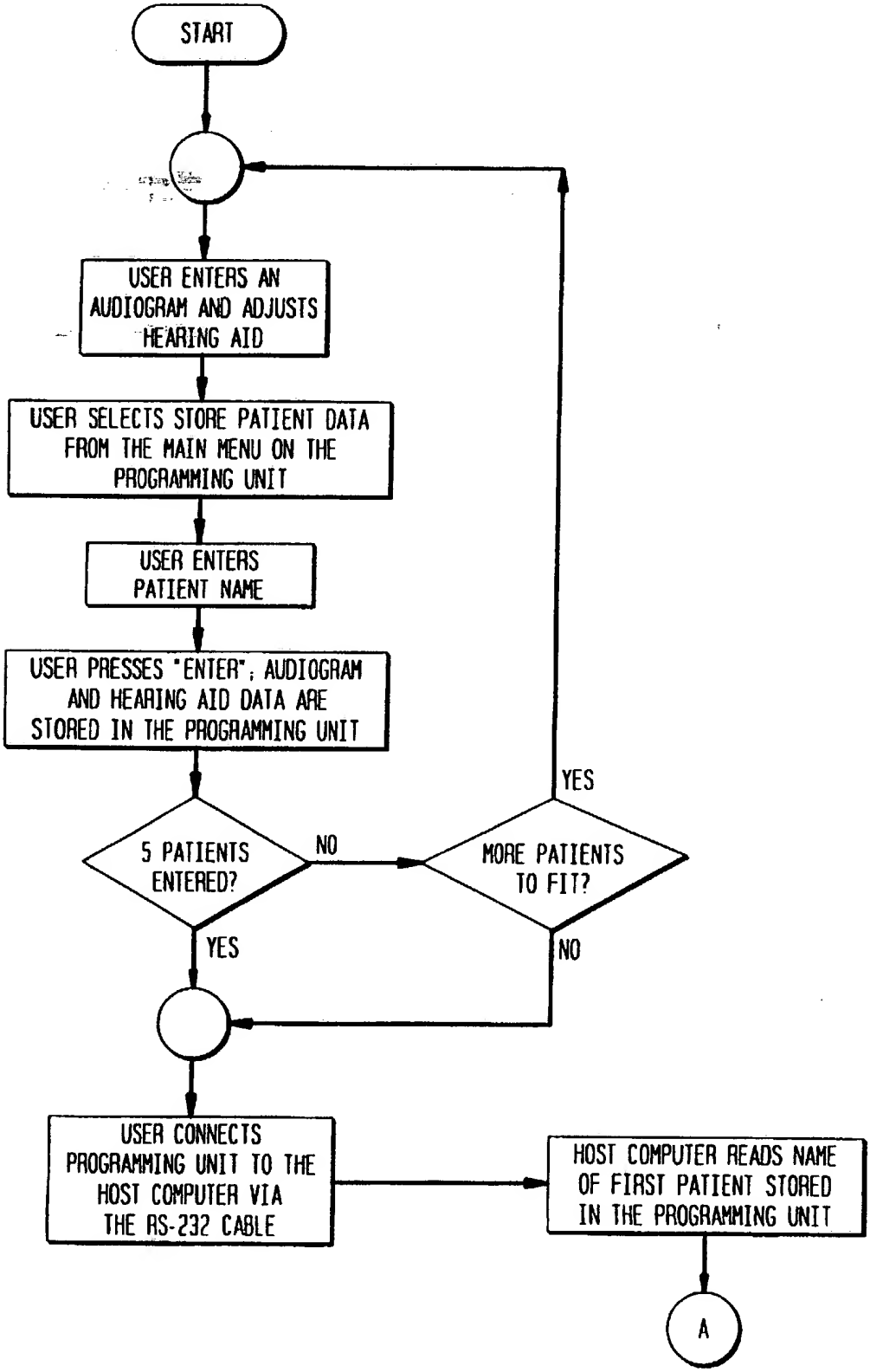

START
USER ENTERS AN AUDIOGRAM AND ADJUSTS HEARING AID
USER SELECTS STORE PATIENT DATA FROM THE MAIN MENU ON THE PROGRAMMING UNIT
USER ENTERS PATIENT NAME
USER PRESSES "ENTER"; AUDIOGRAM AND HEARING AID DATA ARE STORED IN THE PROGRAMMING UNIT
5 PATIENTS ENTERED?
NO
MORE PATIENTS TO FIT?
YES
YES
NO
USER CONNECTS PROGRAMMING UNIT TO THE HOST COMPUTER VIA THE RS-232 CABLE
HOST COMPUTER READS NAME OF FIRST PATIENT STORED IN THE PROGRAMMING UNIT
A

FIG. 5B

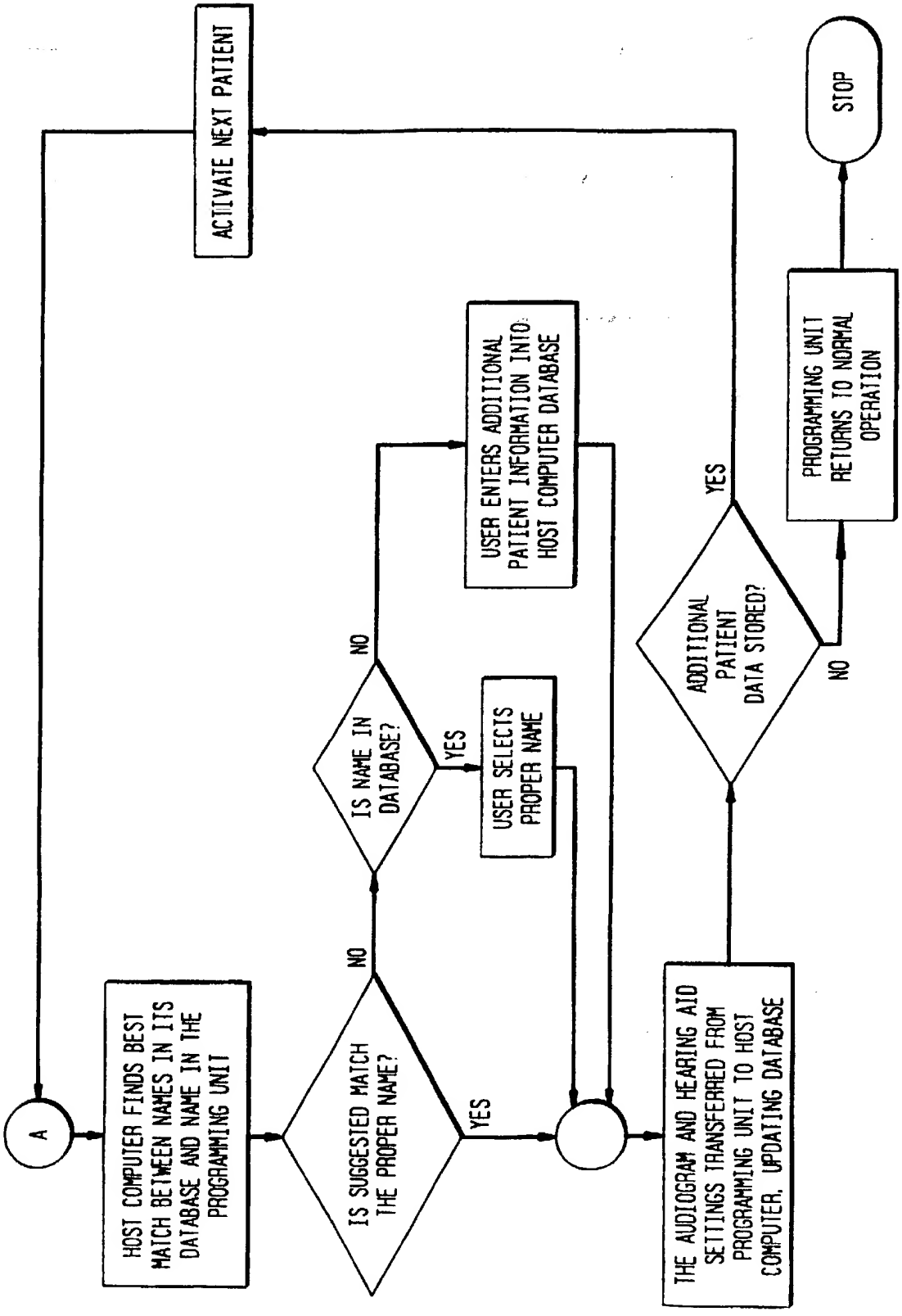
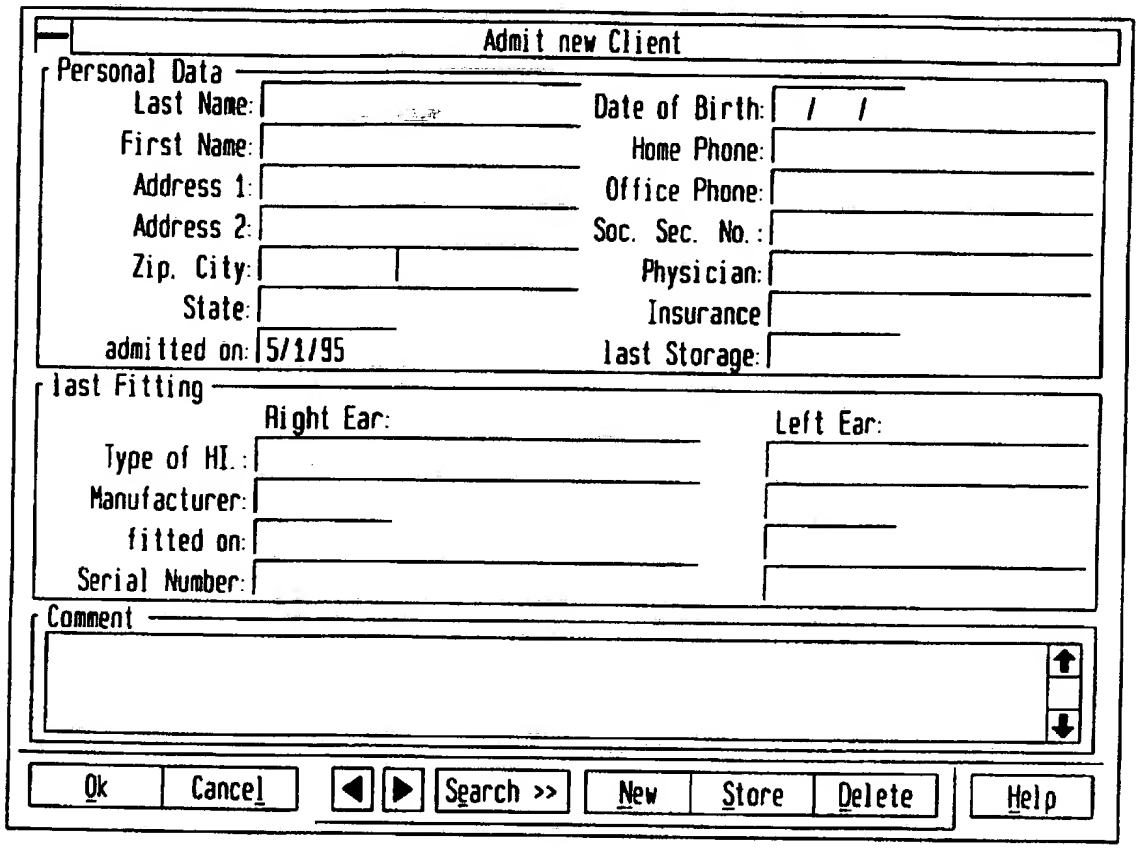

A
HOST COMPUTER FINDS BEST MATCH BETWEEN NAMES IN ITS DATABASE AND NAME IN THE PROGRAMMING UNIT
IS SUGGESTED MATCH THE PROPER NAME?
NO
YES
IS NAME IN DATABASE?
NO
YES
USER SELECTS PROPER NAME
USER ENTERS ADDITIONAL PATIENT INFORMATION INTO HOST COMPUTER DATABASE
THE AUDIOGRAM AND HEARING AID SETTINGS TRANSFERRED FROM PROGRAMMING UNIT TO HOST COMPUTER, UPDATING DATABASE
ADDITIONAL PATIENT DATA STORED?
YES
NO
PROGRAMMING UNIT RETURNS TO NORMAL OPERATION
STOP
ACTIVATE NEXT PATIENT

FIG. 6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Personal Data
Last Name:
First Name:
Address 1:
Address 2:
Zip. City:
State:
admitted on:
5/1/95
Date of Birth:
/ /
Home Phone:
Office Phone:
Soc. Sec. No.:
Physician:
Insurance
last Storage:
last Fitting
Right Ear:
Left Ear:
Type of HI.:
Manufacturer:
fitted on:
Serial Number:
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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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IPC 6 H04R H04B G06F A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	see column 1, line 1-4 see column 2, line 40-49 see column 3, line 53 - column 4, line 48 see column 8, line 36 - column 10, line 25	3

Y	US 4 284 847 A (BESSERMAN) 18 August 1981	1,2,4-8
A	see column 2, line 3-27 see column 2, line 50 - column 3, line 10 see column 4, line 5 - column 7, line 9 see column 10, line 24-39	3

A	DE 40 23 785 A (MÜLLER & SEBASTIANI) 30 January 1992 see column 1, line 3-10 see column 2, line 22-44 see column 4, line 67 - column 5, line 36	1-8

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[X] Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
7 February 1997	- 5. 03. 97

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INTERNATIONAL SEARCH REPORT

Internatic Application No
PCT/US 96/16397

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Internatio \pplication No
PCT/US 96/16397

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		DE-T-	69004723	28-04-94
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